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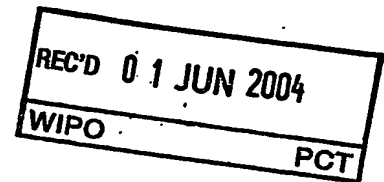
Sertifikaat

Certificate

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**PATENT OFFICE
DEPARTMENT OF TRADE AND
INDUSTRY**

Hiermee word gesertifiseer dat
This is to certify that



the documents annexed hereto are true copies of:

Application forms P.1 and P.3, provisional specification and drawings of South African Patent Application No. 2003/6211 as originally filed in the Republic of South Africa on 11 August 2003 in the name of CSIR for an invention entitled: "PROTECTING A WHEELED VEHICLE " .

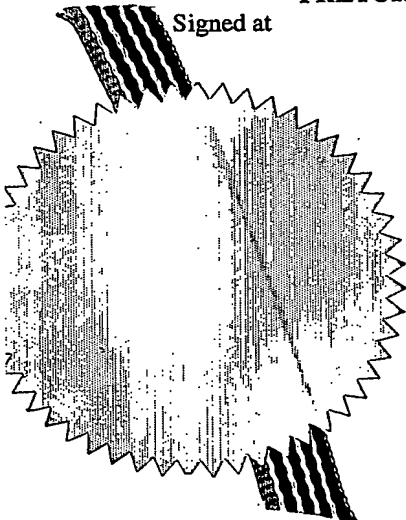
**PRIORITY
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Geteken te
PRETORIA
Signed at

in die Republiek van Suid-Afrika, hierdie
in the Republic of South Africa, this

10th dag van
May 2004
day of

.....
Registrar of Patents



REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978
APPLICATION FOR A PATENT AND
ACKNOWLEDGEMENT OF RECEIPT
(Section 30(1) Regulation 22)

FORM P.1 REVENUE
(to be lodged in duplicate)

11.08.03

R 060.90

THE GRANT OF A PATENT IS HEREBY REQUESTED BY THE UNDERMENTIONED APPLICANT
ON THE BASIS OF THE PRESENT APPLICATION FILED IN DUPLICATE

21 01 PATENT APPLICATION NO. 2003/6211

71 FULL NAME(S) OF APPLICANT(S)

CSIR

ADDRESS(ES) OF APPLICANT(S)

SCIENTIA, PRETORIA, GAUTENG, REPUBLIC OF SOUTH AFRICA

54 TITLE OF INVENTION

PROTECTING A WHEELED VEHICLE

Only the items marked with an "X" in the blocks below are applicable.

☐ THE APPLICANT CLAIMS PRIORITY AS SET OUT ON THE ACCOMPANYING FORM P.2. The earliest priority claimed is

Country:

No:

Date:

☐ THE APPLICATION IS FOR A PATENT OF ADDITION TO PATENT APPLICATION NO

21 01

☐ THIS APPLICATION IS A FRESH APPLICATION IN TERMS OF SECTION 37 AND BASED ON
APPLICATION NO

21 01

THIS APPLICATION IS ACCOMPANIED BY:

- ☒ A single copy of a provisional specification of 8 pages
☒ Drawings of 2 sheets
☐ Publication particulars and abstract (Form P.8 in duplicate) (for complete only)
☐ A copy of Figure of the drawings (if any) for the abstract (for complete only)
☐ An assignment of invention
☐ Certified priority document(s). (State quantity)
☐ Translation of the priority document(s)
☐ An assignment of priority rights
☐ A copy of Form P.2 and the specification of RSA Patent Application No
☒ Form P.2 in duplicate
☐ A declaration and power of attorney on Form P.3
☐ Request for ante-dating on Form P.4
☐ Request for classification on Form P.9
☐ Request for delay of acceptance on Form P.4
☐ Extra copy of informal drawings (for complete only)

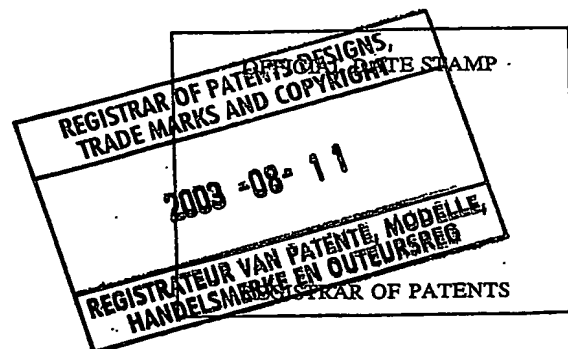
21 01

74 ADDRESS FOR SERVICE: Adams & Adams, Pretoria

Dated this 11th day of August 2003

ADAMS & ADAMS
APPLICANTS PATENT ATTORNEYS

The duplicate will be returned to the applicant's address for service as
proof of lodging but is not valid unless endorsed with official stamp



PATENT APPLICATION NO		
21	01	

A&A Ref: V15866 SCF/cve

LODGING DATE	
22	11 AUGUST 2003

FULL NAME(S) OF APPLICANT(S)	
71	CSIR

FULL NAME(S) OF INVENTOR(S)	
72	JOYNT, Vernon Peregrin

EARLIEST PRIORITY CLAIMED	COUNTRY	NUMBER	DATE
	33 -	31 -	32 -

NOTE: The country must be indicated by its International Abbreviation - see schedule 4 of the Regulations

TITLE OF INVENTION	
54	PROTECTING A WHEELED VEHICLE

* I/We

STRYDOM, Johan

hereby declare that :-

1. ~~I/we am/are the applicant(s) mentioned above;~~
- ** 2. I/we have been authorized by the applicant(s) to make this declaration and have knowledge of the facts herein stated in the capacity of **TECHNOLOGY MANAGER** of the applicant(s);
- *** 3. the inventor(s) of the abovementioned invention is/are the person(s) named above and the applicant(s) has/have acquired the right to apply by virtue of an assignment from inventor (s).
4. to the best of my/our knowledge and belief, if a patent is granted on the application, there will be no lawful ground for the revocation of the patent;
- **** 5. ~~this is a convention application and the earliest application from which priority is claimed as set out above is the first application in a convention country in respect of the invention claimed in any of the claims; and~~
6. the partners and qualified staff of the firm of **ADAMS & ADAMS**, patent attorneys, are authorised, jointly and severally, with powers of substitution and revocation, to represent the applicant(s) in this application and to be the address for service of the applicant(s) while the application is pending and after a patent has been granted on the application.

SIGNED THIS

6

DAY OF

October

2003

J. Strydom
Company Name: CSIR
Full Names: STRYDOM Johan
Capacity: Technology Manager

(no legalization necessary)

- * In the case of application in the name of a company, partnership or firm, give full names of signatory/signatories, delete paragraph 1, and enter capacity of each signatory in paragraph 2.
- ** If the applicant is a natural person, delete paragraph 2.
- *** If the right to apply is not by virtue of an assignment from the inventor(s), delete "an assignment from the inventor(s)" and give details of acquisition of right.
- **** For non-convention applications, delete paragraph 5.

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PATENT ATTORNEYS
PRETORIA

FORM P6

REPUBLIC OF SOUTH AFRICA
Patents Act, 1978

PROVISIONAL SPECIFICATION

(Section 30 (1) - Regulation 27)

21	01	OFFICIAL APPLICATION NO
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••• 2003 / 6 2 1 7

22	LODGING DATE
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11 August 2003

71	FULL NAME(S) OF APPLICANT(S)
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CSIR

72	FULL NAME(S) OF INVENTOR(S)
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JOYNT, Vernon Peregrin

54	TITLE OF INVENTION
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PROTECTING A WHEELED VEHICLE

This invention relates to a method of protecting a wheeled vehicle against the effects of a landmine explosion. It refers also to a wheel and to a wheeled vehicle.

5 When a vehicle sets off a landmine, generally the landmine explodes underneath a wheel or track of the vehicle. This invention addresses the situation when a landmine explodes underneath a wheel of a wheeled vehicle.

10 In accordance with a first aspect of this invention, broadly, there is provided a method of guiding shock waves, generated in a landmine explosion underneath a wheel of a wheeled vehicle, away from a body or hull of the vehicle by means of a guide member positioned in or on the wheel and oriented to guide the shock waves obliquely in a laterally outward and upward direction.

15 Terms denoting direction should be interpreted in relation to normal forward movement of the vehicle. Thus, a laterally outward and upward direction is to be interpreted that the direction has components in the upward direction and in a lateral direction away from the body or hull of the vehicle.

20 The method may include absorbing energy by means of a liquid provided in a tyre of the vehicle, in the case that the wheels have tyres.

25 In accordance with a second aspect of this invention, there is provided a wheeled vehicle including guide members in at least some (e.g. front) wheels of the vehicle, each guide member being positioned in or on a respective wheel and being oriented to direct shock waves, generated by a landmine

explosion underneath the respective wheel, obliquely in a laterally outward and upward direction.

5 The guide member may include a primary material having an acoustic speed higher than that of steel, e.g. a glass or ceramic material. The guide member may be in laminated form comprising laminates of the primary material interposed by an interface material having an acoustic speed lower than that of steel, the laminates being directed generally in said laterally outward and upward, oblique direction. The interface material may be a synthetic polymeric material. Said interface material may have an acoustic speed lower than that of air.

15 The guide member may be positioned annularly inward of a tread of the wheel. It may be annularly around a hub of the wheel. It is preferably acoustically well coupled to a wheel frame (colloquially referred to as a wheel rim).

20 When the wheel has an inflatable tyre, the guide member may be positioned annularly within said tyre.

By way of development, when the wheel has an inflatable tyre, the tyre may contain a liquid for absorbing some of the energy of the explosion. The liquid may be selected to have an appropriate boiling point and coefficient of latent heat of evaporation. It may, for example, be water, glycerin, a mixture, or the like.

The invention extends to a wheel including a guide member, as herein described.

30 The invention is now described by way of example with reference to the accompanying diagrammatic drawings. In the drawings

Figure 1 shows, fragmentarily, in radial section, a first embodiment of a wheel in accordance with the invention; and

Figure 2 shows, in a view corresponding to that of Figure 1, a second embodiment.

5

With reference to Figure 1 of the drawings, a wheel in accordance with the invention is generally indicated by reference numeral 10. The wheel 10 is a solid wheel, i.e. not a pneumatic wheel or inflatable wheel. It is generally of sturdy construction and suitable for use in traversing a minefield to detonate anti-personnel mines. It is to be understood that it will be mounted to a vehicle. In accordance with the invention, the wheel 10 is suitable to protect a body or hull of the vehicle and thus also an occupant of the vehicle against the effect of a powerful landmine, such as an anti-tank mine, which may be encountered in a field of generally anti-personnel mines.

15

The wheel 10 comprises a wheel frame 12 having a hub 14 defining a hub volume 15 via which the wheel 10 is mounted to the vehicle in any appropriate fashion. The wheel frame 12 comprises, at an outer periphery thereof, a peripheral flange 16. A tread 18 in the form of a hoop of an appropriate grade of steel is mounted via the peripheral flange 16 to the wheel frame 12.

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In accordance with the invention, in an annular space radially within the tread 18, there is provided a guide member 20 which is conveniently a composite member comprising a plurality of segments, together forming an annular construction.

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Each section of the guide member 20 is of generally triangular cross-section comprising a plurality of laminates 22 with layers of dividing material in the form of dividers 24 being sandwiched in-between adjacent laminates 22. The laminates 22 and the dividers 24 form a parallel directed

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structure pointing radially inwardly and laterally outwardly. If a bottom segment of the wheel 10 is viewed, the laminates 22 and dividers 24 are directed obliquely upwardly and laterally outwardly. It is to be appreciated that the side of the wheel 10 having the wheel frame 12 will be proximate a body or hull of a vehicle to which the wheel 10 is mounted. That side, indicated by reference numeral 40, will be referred to as the protected side, as the body or hull, and the occupant of the vehicle are to be protected against the effects of a landmine explosion taking place underneath the tread 18.

The laminates 22 are of a material having a high acoustic speed, whereas the dividers 24 are of a yielding, even resilient, material having a low acoustic speed, such as a synthetic polymeric material, for example polyurethane, rubber, or the like.

In the event of a landmine explosion underneath the tread 18, shock waves generated by the landmine explosion will propagate through the tread 18 and will be "loaded" into the guide member 20 via a surface 26 thereof proximate the tread 18. The applicant has realized that shock waves encounter resistance to propagation inversely proportional to the acoustic speed of a material. Thus in a material having a high acoustic speed like glass, or especially ceramic, such as that of the laminates 22, the shock waves are propagated well along such high acoustic speed material. It is further to be appreciated that the dividers 24 are of a material having a very low acoustic speed and thus offering very high resistance to propagation. In fact, a combination of a high acoustic speed material backed by a low acoustic speed material acts as a mirror for shock waves, thus deflecting or reflecting the shock wave back into the high acoustic speed material. In the embodiment illustrated, it is expected that shock waves traveling generally directly upwardly through the tread 18 into the respective laminates 22, will be guided obliquely laterally outwardly generally along the laminates 22 as deflection or reflection takes place at each interface between the respective laminates and their backing dividers 24. It is furthermore

to be appreciated that the laminate 22 at the extremity is flanked by air, which also has a low acoustic velocity and deflecting will thus also take place along the extreme laminate 22.

5 Thus, it is expected that shock waves will be propagated obliquely upwardly and laterally outwardly from the surface 26 to a lateral surface 28 along an annular side of the guide member 20 and thus toward an outside, indicated by reference numeral 42 of the vehicle.

10 When the shock waves reach the surface 28 of the guide member 20, the shock waves, when they encounter the neighboring air, which has a low acoustic speed, cause spalling of the material which results in a fragment or fragments of material to be liberated and to be projected generally in the direction of spalling, i.e. generally laterally outwardly.

15 In this regard, the applicant has realized that a blast effect generated by the landmine explosion and following the shock waves in time, generally follows the path or route of least resistance. In this regard, the application has further appreciated that the shock waves crack and pulverize the
20 material of the laminates 22, but at a propagation speed substantially lower than the acoustic speed. Thus, the laminates 22 remain intact fully to propagate the shock waves, but immediately behind the shock waves, crack and pulverize to facilitate being displaced or blown away by the blast effect. Thus a route of least resistance is created in the direction in which the shock waves were directed.
25 Furthermore, the effect of spalling and of a fragment or fragments being projected from the outer surface 28 create a region of low pressure which is followed by the blast effect.

30 Thus, the applicant has realized that managing or guiding of the shock waves in a predetermined direction away from a body or hull of the vehicle not only protects the body or hull against the effects of the shock waves, but also

that the blast effect tends to follow the leader shock waves and that the body or hull of the vehicle is thus also protected against the effects of the blast.

With reference to Figure 2, a further, developed embodiment of a wheel in accordance with the invention is generally indicated by reference numeral 110. In many respects, the wheel 110 resembles the wheel 10 and its construction and operation are not fully described again.

The wheel 110 includes a wheel frame 112 having an outer peripheral rim 116 seating an inflatable tyre 119 having side walls 119.1 and a tread 119.2. A steel tread 118 in the form of a hoop and of an appropriately durable material such as steel which is resistant to explosions of anti-personnel mines, could be used. The steel tread 118 has, along side edges thereof, laterally inwardly directed flanges 118.1 for seating over the tyre tread 119.2 and thus to prevent the steel tread 118 from unseating. It is to be appreciated that the steel tread 118 will be positioned over the tyre 119 when the tyre is deflated.

Within the tyre 119, there is provided a guide member 120 similar to the guide member 20 of Figure 1. The guide member 120 may be secured to the rim 116 in any convenient and appropriate fashion, for example by means of an annular, frame-like securing member 130 which is shown schematically. The guide member 120 has laminates 122 interposed by dividers 124 of materials similar to those described with reference to Figure 1.

The mechanism of guiding of shock waves in the wheel 110 is similar to that described with reference to the wheel 10 and it is thus not repeated.

By way of development, the volume within the tyre 119 is advantageously filled by means of a liquid 132. The liquid 132 is selected to be effective in absorbing energy associated with the landmine explosion. The liquid

may have a relatively low boiling point and its latent heat of evaporation will be selected to absorb energy in the form of heat. A layer of liquid between the steel tread 118, and the face 126, will promote acoustic coupling and thus "loading" of the shock waves into the guide member 120.

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It is to be appreciated that the wheel 110 of Figure 2 has the advantage that it has some resilience providing a suspension effect and is thus expected to allow a vehicle to travel faster than a vehicle rolling along wheels of the kind of Figure 1.

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The invention has the advantage that a vehicle shod with wheels for traversing a minefield to detonate anti-personnel mines in the minefield, is protected against the effects of any high powered landmine, such as an anti-tank landmine, which may be laid in the minefield being cleared.

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The invention is applicable in principle also in other kinds of wheels, for example, an annular guide member as described may be positioned

within a well of a wheel frame having a "soft" tyre, i.e. a pneumatic tyre, a solid moulded tyre of rubber, polyurethane, or the like, whether or not such a wheel has an outer hoop of steel or other explosion resistant material;

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within a pneumatic tyre (tubed or tubeless) when the wheel does not have the outer hoop as in Figure 2;

moulded within a moulded solid tyre of rubber, polyurethane or the like, whether or not such a wheel has an outer hoop of steel or other explosion resistant material.

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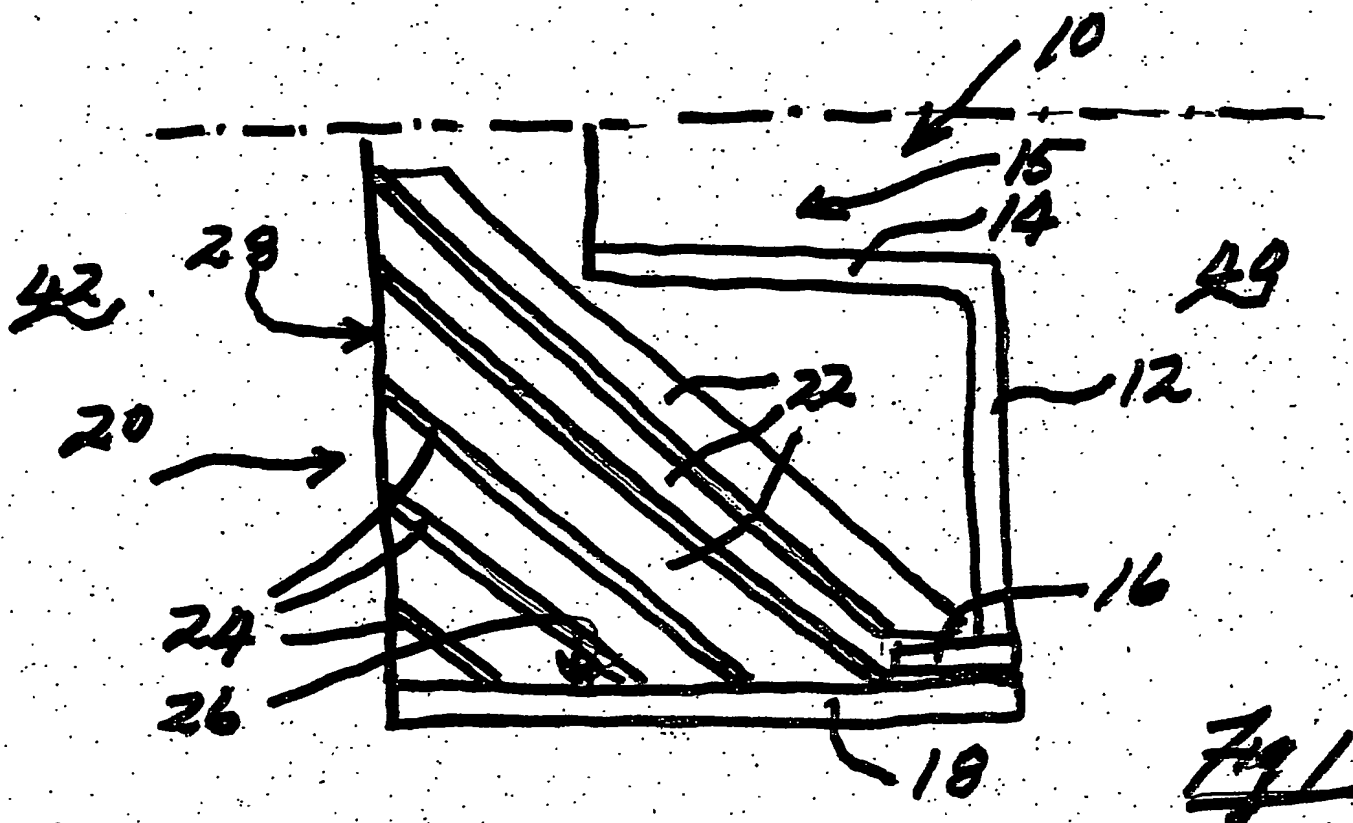
DATED THE 11th DAY OF AUGUST 2003

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ADAMS & ADAMS

APPLICANT'S PATENT ATTORNEYS



Handwritten signature

CSIR

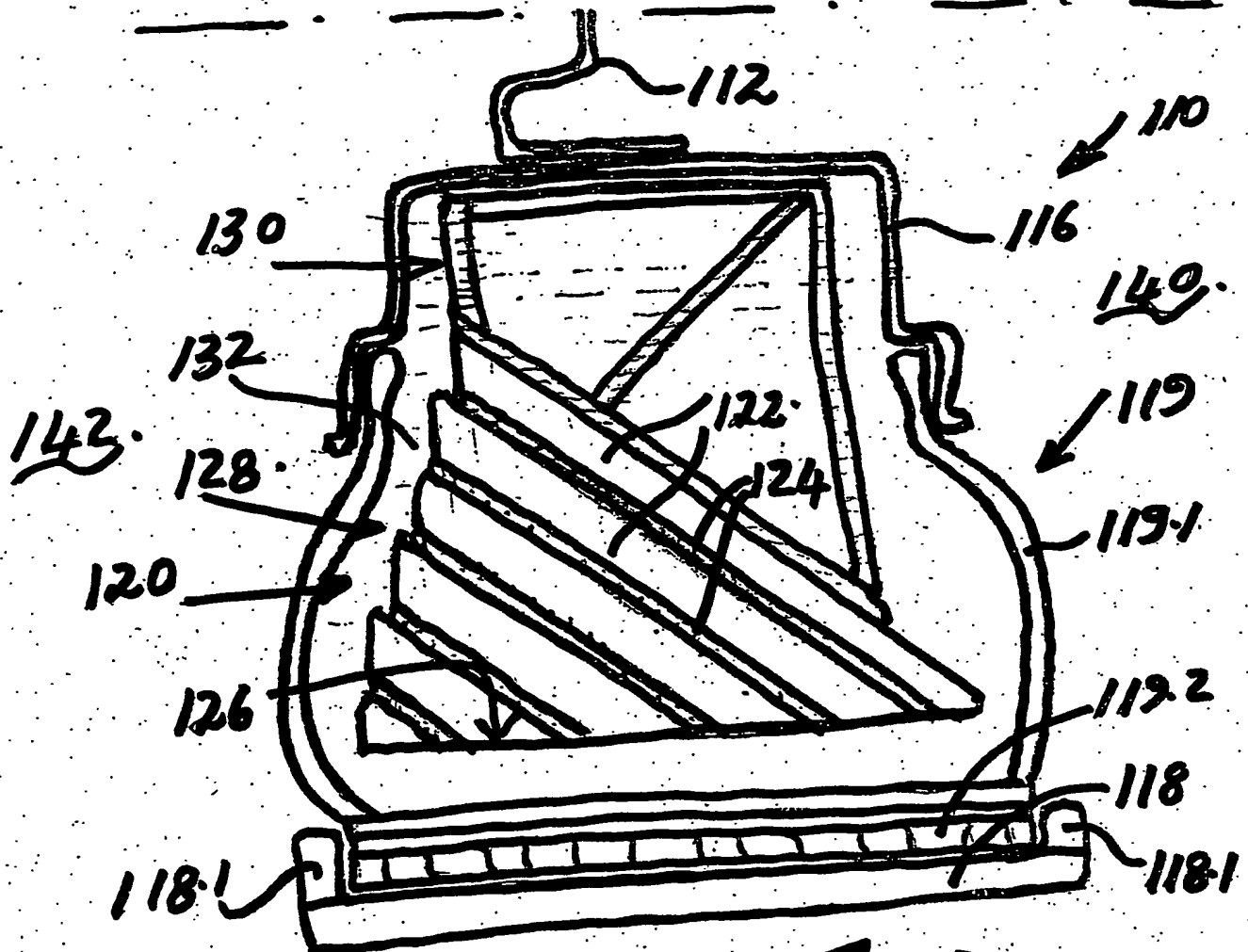


Fig 2

[Signature]